



ABLATION AND SENSING UNIT (ASU)

SERVICE MANUAL

**Model ASU2-115
ASU3-230**

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1. **Introduction**

This Service Manual is designed to provide instructions for the servicing of the AtriCure Ablation and Sensing Unit (ASU). It is not a reference to surgical technique. A separate manual, the “Ablation and Sensing Unit (ASU) User’s Manual,” is designed to provide instructions for use.

Federal (USA) law restricts this device to sale by or on the order of a physician.

Please read all information carefully. Failure to properly follow the instructions may lead to serious consequences.

For the user’s convenience, the AtriCure Ablation and Sensing Unit will be referred to in this Service Manual as the “ASU”. The AtriCure Bipolar Handpiece will be referred in this Service Manual as the “Handpiece”.

This manual is intended as a Service Manual only. For a complete description of the ASU, its controls, displays, indicators, tones and a sequence for its operation with the Handpiece please refer to the User’s Manual. The User’s Manual also supplies other information of importance to the user.

Do not operate the ASU before thoroughly reading the User’s Manual.

1.1. **System Description**

The system is comprised of the following:

- AtriCure Bipolar Handpiece with integral cable
- AtriCure Ablation and Sensing Unit (ASU)
- Footswitch
- Power cord

2. Warnings and Precautions



The safe and effective use of RF energy is highly dependent upon factors under the control of the operator. There is no substitute for a properly trained operating room staff. It is important that the operating instructions supplied with the ASU be read, understood and followed before use.

2.1. WARNINGS

- Fire Hazard: Electrosurgical accessories that are activated or hot from use can cause a fire. Do not place them near or in contact with flammable materials.
- Fire Hazard: Do not use extension cords.
- Fire Hazard: To avoid igniting cleaning agents, use only non-flammable agents to clean and disinfect the ASU. If flammable agents are inadvertently used on the ASU, allow these substances to evaporate completely before operating.
- Trip Hazard: Standard care should be used to reduce the risk of tripping on the Footswitch cable.



The voltage selector is factory set and should not be changed by the user. The voltage selector and the power entry module must be set to the same voltage setting to prevent ASU malfunction and potential instrument damage.



Electric Shock Hazard: Connect the ASU Power Cord to a properly grounded receptacle. Do not use power plug adapters.



Electric Shock Hazard: Do not connect wet accessories to the generator.



Electric Shock Hazard: Ensure that the Handpiece is correctly connected to the ASU and that no wires are exposed from the cable, connector or Handpiece.

2.2. PRECAUTIONS

- Do not disable the audible tone.



Do not remove the ASU cover, as there is a potential for electrical shock. Refer to authorized personnel for service.

- Use only the Footswitch provided with the ASU.
- The Power Cord of the ASU must be connected to a properly grounded receptacle. Extension cords and/or adapter plugs must not be used.



Do not wrap instrument cable around metal objects. Wrapping cables around metal objects may induce hazardous currents.

- Failure of the ASU and Handpiece could result in unintended power output increases.

2.3. Responsibility of the Manufacturer

AtriCure is responsible for safety, reliability, and performance of the equipment only if:

- Installation procedures in the User's manual are followed.
- Other than fuse replacement, only persons authorized by AtriCure carry out modifications or repairs.
- The electrical installation of the relevant room complies with local codes and regulatory requirements such as UL, IEC and BSI.
- The equipment is used in accordance with the AtriCure User's Manual.

3. Technical specifications

3.1. RF Output

- Frequency: 460.8 kHz \pm 5%, Quasi-sinusoidal
- RF Power Output: Refer to the Power vs. Load Impedance output curve, Figure 1.
- RF Voltage Max: 57 Vrms \pm 10% (Device Code A, D, E, F, G, and H)
77.5 Vrms \pm 10% (Device Code B, C, J, K, and L)

3.2. Mechanical Specifications

- Size: 13" x 13.75" x 6" (32.5 cm x 34.4cm x 15 cm) maximum
- Weight: 15 lb. (9 kg) maximum

3.3. Environmental Specifications

- Operational temperature: 10°C to 40°C
- Storage temperature: -35°C to +60°C
- Humidity: 15% to 90% relative humidity

3.4. Electrical Specifications

- 100V – 120V ~ 50/60 Hz
- 220V – 240V ~ 50/60 Hz

3.5. Fuses

- **100V – 120V, 220V – 240V, ~50 / 60 Hz**
Replace fuses as marked:
1.25A/250V, T-lag, 5x20mm, UL Recognized, IEC Approved. AtriCure P/N C000322.

3.6. Footswitch Specifications

- Moisture protection rating: **IPX8**

3.7. Power and Voltage Output Restrictions

- Power output is available over a 20Ω - $1,000\Omega$ range.
- The maximum power and voltage output,

Device Code	Maximum Output Power	Maximum Output Voltage
A	28.5 W at 114Ω	57.0 Vrms
B	15.0 W from 26.3Ω to 400Ω	77.5 Vrms
C	20.0 W from 31.3Ω to 300Ω	77.5 Vrms
D	25.6 W at 127Ω	57.0 Vrms
E	22.8 W at 143Ω	57.0 Vrms
F	28.5 W at 114Ω	57.0 Vrms
G	28.5 W at 114Ω	57.0 Vrms
H	28.5 W at 114Ω	57.0 Vrms
J	12.0 W from 20.0Ω to 500Ω	77.5 Vrms
K	25.0 W from 39.1Ω to 240Ω	77.5 Vrms
L	30.0 W from 46.9Ω to 200Ω	77.5 Vrms

At other load impedances, the ASU will reduce the available power to comply with the specified voltage and current limits. See Figure 1 and Figure2 below.

Note: Device code F is programmed into the STK1 test cable, which is displayed in the upper right hand corner of the ASU screen.

ASU2 & ASU3 POWER OUTPUT

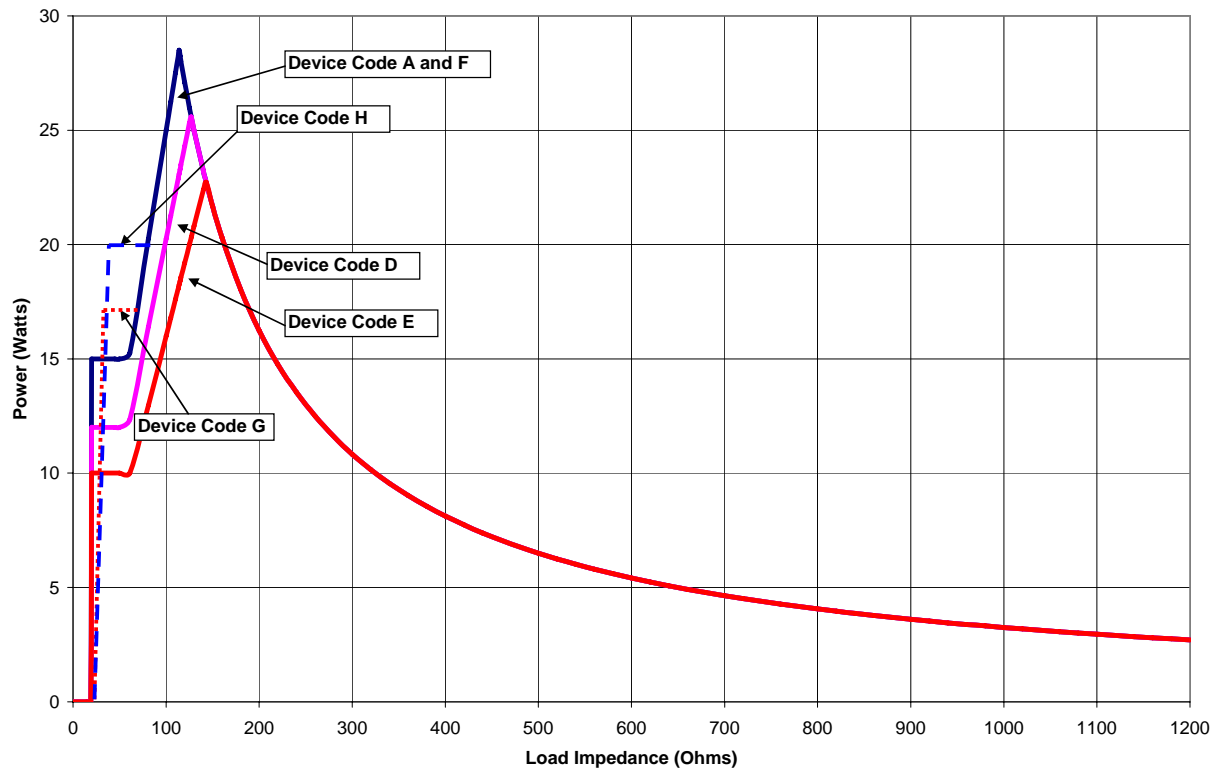


Figure 1 – Power vs. Load (clamp algorithm)

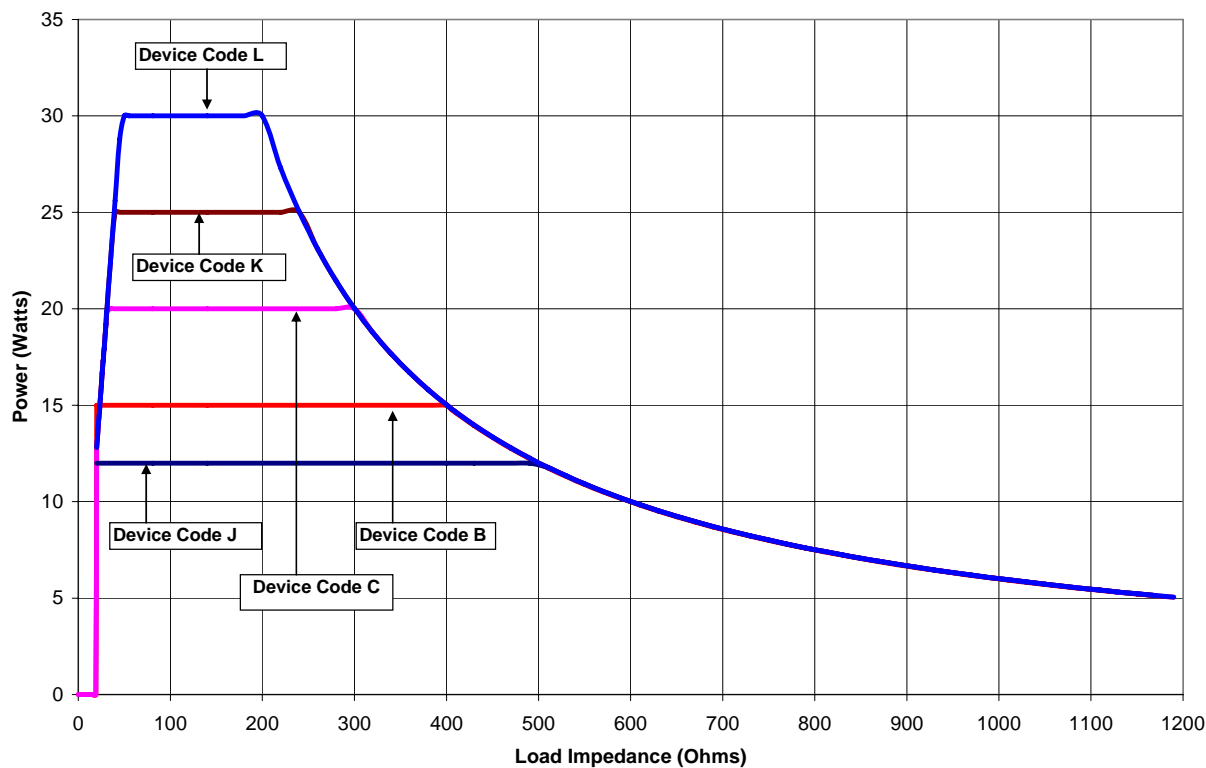
ASU2 & ASU3 POWER OUTPUT

Figure 2 – Power vs. Load (pen algorithm)

4. Theory of Operation

This unique system is not just another radio frequency generator. Using discrete field bipolar radio frequency, the AtriCure ASU delivers targeted ablative energy while simultaneously measuring the change in conductive properties of the lesion as it is created.

The ASU produces and delivers RF energy, in a bipolar mode, at a frequency of approximately 460 kHz, with a maximum power as indicated in Section 3.7. The AtriCure ASU is designed to operate with the AtriCure Handpiece. The ASU and Handpiece are designed for use without a neutral electrode. The Footswitch is the input device used to activate RF energy delivery.

5. Power on Self-Test

The ASU goes through a Power On Self Test (POST) every time the power switch is turned on. The POST is software driven; it is a comprehensive test of the generators components. If an Error is generated during this test, the ASU goes into FAULT Mode. This Mode is entered upon detection of any unrecoverable error condition during any Mode of operation. The system is inoperable in this Mode until the power is cycled off, then on.

At startup the Self-Test generates two quick beeps, the temperature display lights up, and indicator lights come on. The operator must verify that the beeps are generated and that all the temperature and indicator lights come on during the test.

Below is a comprehensive list of the tests that are performed during the Power On Self Test:

Power Measurement and Delivery Test:

This test connects an internal 350Ω test load to the RF power generation circuit and delivers 15 Watts into the test load.

The error codes are:

- **Code P01:** the measured power and the power set point differ more than 1.5 Watts,
- **Code P02:** the measured impedance and the test load impedance differ more than 35Ω,
- **Code P03:** the measured voltage and the expected voltage differ more than 7 Volts,
- **Code P04:** the measured current through the test load and the expected current differ more than 20 mA.

RF Watchdog Shutdown Test:

The RF Watchdog timer is tested by allowing it to timeout and shutoff the RF power.

- **Code P05** is generated if the RF power is still ON after 500 ms without RF Watchdog strobe.

ROM Test Error :

The ROM CRC is computed and verified against the pre-installed CRC and ensures the ROM data integrity.

- **Code P06** is generated if the computed CRC does not match the pre-installed CRC.

RAM Test Error:

The entire RAM space is tested using the “walking bit pattern” test and ensures the RAM addressing and data integrity.

- **Code P07** is generated if the written data does not match the data read back.

Configuration Register Error

- *Code P08* is generated if a configuration register error is detected.

MCU COP Error

- *Code P09* is generated if the COP watchdog timer expires.

Switch Stuck Test

- *Code P10* is generated if the Footswitch is depressed during the POST.

Real Time Clock Test

- *Code P11* is generated if the date and time of the Real Time Clock are not valid.

Reference Voltage Test

- *Code P12* is generated if one of the three reference voltages is not within a given range when compared against the corresponding nominal voltage.

6. Optional Performance Verification Procedure

The ASU does not have any customer serviceable parts. The manufacturer does not require or recommend routine calibration/output verification.

As stated in **Section 5**, the ASU performs its own maintenance check every time it is powered ON. The check is called the Power On Self Test (POST). This test is software driven and is a comprehensive test of the generators components. No calibration is needed; the unit will generate an unrecoverable error if further maintenance is needed.

If an organization determines that more system tests are required, then an optional performance verification procedure can be performed per this section. The ASU should perform as indicated; any deviation should be a cause for concern. These tests are optional, but should be performed as indicated to insure accuracy.

6.1. Tools Needed

Tools needed to complete optional performance verification procedure:

- ASU Service Test Cable. Available through AtriCure. Part Number A000075.
- 50Ω , 100Ω, and 200Ω Load
- Oscilloscope, capable of reading both Voltage and Current

6.2. Indicators

These tests are to confirm that the indicator lights are functioning properly.

1. Plug in AC power cord into a grounded receptacle and power ON the ASU.
NOTE: Do not use extension cords or three-prong to two-prong adapters.
 - The ASU will perform a Self-Test, the contents of which are covered in **Section 5** of this manual. The Self-Test generates two quick beeps at startup. The operator must verify that the beeps are generated.
2. Plug in footswitch and Service Test Cable.
 - The ready light will illuminate and temperature display will show a numerical temperature reading.
3. Unplug footswitch.
 - The ready light will turn off and temperature display will go blank.
4. Plug in footswitch.
 - The ready light will turn on and temperature display will show a numerical temperature reading.
5. Unplug Service Test Cable.
 - The ready light will turn off and temperature display will go blank.
6. Plug in Service Test Cable.
 - The ready light will turn on and temperature display will show a numerical temperature reading.
7. Connect the 100Ω to the RF electrode alligator clips on the Service Test Cable, and depress the footswitch.
 - The RF ON light will turn on and Constant medium-pitched tone will sound.
8. Deactivate the footswitch.
 - The RF ON light will turn off.

6.3. Power Output

This test is to confirm the ASU is putting out the correct power.

NOTE: It is assumed that the one performing these tests has a basic knowledge of how to operate the Oscilloscope in use. The accuracy of the measurement will vary with the test equipment used.

1. With footswitch and Service Test Cable plugged in and the ASU in STANDBY, connect the load impedance of interest as identified below to the Service Test Cable.
2. Place the Voltage leads from the Oscilloscope on either side of the load impedance.
3. (Optional) Clip the Current lead from the Oscilloscope on to either of the RF wires connected to the banana jacks.
4. Depress the footswitch and take the Voltage and Current readings from the Oscilloscope.
5. Using the Voltage and/or Current measurements calculate the power output using $P=I^2R$ or $P=IV$ or $P=V^2/R$

Device Code	Load Impedance	Power Output	Measured Current	Measured Voltage
A	50Ω	15.0W	0.55A	27.4V
	100Ω	25.0W	0.50A	50.0V
B	50Ω	15.0W	0.55A	27.4V
	100Ω		0.39A	38.7V
C	50Ω	20.0W	0.63A	31.6V
	200Ω		0.32A	63.2V
D	50Ω	12.0W	0.49A	24.5V
	100Ω	20.3W	0.45A	45.0V
E	50Ω	10.0W	0.45A	22.4V
	100Ω	16.0W	0.40A	40.0V
F	50Ω	15.0W	0.55A	27.4V
	100Ω	25.0W	0.50A	50.0V
G	50Ω	15.0W	0.55A	27.4V
	100Ω	25.0W	0.50A	50.0V
H	50Ω	15.0W	0.55A	27.4V
	100Ω	25.0W	0.50A	50.0V
J	50Ω	10.0W	0.45A	22.4V
	200Ω		0.22A	44.7V
K	50Ω	25.0W	0.71A	35.4V
	200Ω		0.35A	70.7V
L	50Ω	30.0W	0.77A	38.8V
	200Ω		0.39A	77.5V

6.4. Errors and Fault Mode

These tests are to confirm that errors are being detected properly.

6.4.1. Error Generation Test

1. With footswitch and service test cable plugged in and no load connected to cable, turn on the ASU.
2. Depress the foot switch.
 - This will cause the ASU to go into ERROR mode.
 - “Replace Handpiece” and **Code E02** will appear at the lower left corner of the display screen and a Constant low-pitched tone will sound.
3. Turn Off the ASU.

6.4.2. Fault Generation Test

1. Depress the footswitch.
2. Turn On the ASU.
 - This will cause the ASU to go into FAULT mode.
 - FAULT and **Code P10** will appear at the lower left corner of the display screen and a rapid succession of low-pitched beeps will sound for a two second duration.
3. Deactivate the footswitch and turn the ASU off and then back on again.
 - This resets the ASU and puts it back into STANDBY mode.

6.5. Thermocouple and Temperature Display

These tests are to confirm the Thermocouple and the Temperature display are functioning properly.

NOTE: Do not depress the footswitch at any time during this test. Doing so may result in injury.

1. A thermocouple is embedded in the cable near the terminal box. With footswitch and Service Test Cable plugged in and the ASU in STANDBY, gently warm the thermocouple by placing your hand directly over the shrink sleeve of the Test Cable near the terminal box. Other means of gently warming the thermocouple may also be effective.
 - The temperature display will show an increase in temperature as your hand warms the thermocouple.
2. Release the shrink sleeve.
 - The temperature display will show a decrease in temperature as the thermocouple approaches room temperature.

6.6. Visual Inspection of ASU

These tests confirm that the external components of the ASU are functioning properly.

1. Inspect the connectors for the Footswitch and Handpiece.
 - Connectors should not be damaged or cracked and should latch when plug is inserted.

2. Do a visual inspection of the Footswitch and electrical power cords.
 - Cords should not be frayed or damaged and electrical power cords should have proper grounding.
3. Verify that the ASU is stable when placed on a flat level surface.
4. Inspect the carrying handle and confirm its ability to latch and rotate.
5. Inspect the LCD display and confirm that it is not cracked or damaged.

7. Troubleshooting

Use the following sections to help troubleshoot possible problems with the ASU.

7.1. No ASU Power

If the ASU does not Power ON, confirm that the ASU is firmly plugged into a grounded receptacle. Verify that the ON/OFF switch is in the ON position.

NOTE: Do not use extension cords or three-prong to two-prong adapters. The power cord assembly should be periodically checked for damaged insulation or connectors.

If the lack of ASU Power persists, replace the fuses using the instructions in **Section 8**.

7.2. No RF Power Output

If there is no RF power output, attempt to correct this problem using the checklist below.

Possible Cause	Solution
ASU not turned on	Turn power on
ASU not plugged in	Confirm electrical connections and then turn power on
No Handpiece connected	Connect Handpiece
No Footswitch connected	Connect Footswitch
ASU in FAULT mode	Turn Power off and then on
ASU in STANDBY mode	Ensure that Handpiece and Footswitch are properly connected
Broken Handpiece cable	Replace Handpiece
Fault in Footswitch	Replace Footswitch
Fault in Handpiece	Replace Handpiece
Internal ASU failure	Contact AtriCure Technical Support

If the lack of ASU RF power output persists, contact AtriCure Technical Support.

7.3. Error Codes

If a fault condition should occur, the numeric displays on the front panel will display an error code. If an Error Code of E07 through E09, PO1 through P11, or F01 through F14 appears, try turning the ASU power off, then on. If the problem persists, contact AtriCure Technical Support.

Use the table below to attempt to resolve the following recoverable application errors.

LCD DISPLAY MESSAGE	DESCRIPTION	SOLUTION
Replace Handpiece H01	Invalid Handpiece Version	Replace Handpiece
Replace Handpiece H02	Time Expired Error: The Handpiece expiration date has been exceeded	Replace Handpiece
Replace Handpiece H03	Handpiece Electrical Problem	Replace Handpiece
Replace Handpiece H04	Invalid Handpiece Version	Replace Handpiece
Check Electrodes E01	Low Impedance Error: Handpiece electrodes touch	Check Electrodes or reposition jaws
Close Jaws E02	High Impedance Error: Handpiece jaws are open	Close Handpiece Jaws
Check Electrodes E03	Low Impedance Error: Handpiece electrodes touch	Check Electrodes or reposition jaws
Check Electrodes E04	Low Impedance Error: Handpiece electrodes touch	Check Electrodes or reposition jaws
HiTemp or Handpiece E05	Open or defective thermocouple, or high sensor temperature	Replace Handpiece, or wait for temperature to drop below 75°C
Check Footswitch E06	Switch Stuck Test Error	Replace Footswitch
Check Footswitch P10	Footswitch closed at power up	Check Footswitch

7.4. Electromagnetic or Other Interference

The ASU has been tested and found to comply with the limits for medical devices in IEC 60601-1-2:2001. These limits are designed to provide reasonable protection against harmful interference in a typical medical installation.

The ASU generates and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other devices in the vicinity. However, there is no guarantee that interference will not occur in a particular installation. If the ASU does cause harmful interference to other devices, which can be determined by turning the ASU off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving device(s).
- Increase the separation between the ASU and the receiving device(s).
- Connect the ASU into an outlet on a circuit different from that to which the receiving device(s) are connected.

- Contact AtriCure Technical Support for help.

Use the following sections to troubleshoot specific types of interference, including monitor (display) interference, neuromuscular stimulation, and pacemaker interference.

7.4.1. Monitor (Display) Interference

7.4.1.1. Continuous Interference

1. Check the Power Cord connections for the ASU.
2. Check all other electrical equipment in the operation room for defective grounds.
3. If the electrical equipment is grounded to different objects, rather than a common ground, voltage differences can appear between the two-grounded objects. The monitor may respond to these voltages. Some types of input amplifiers can be balanced to achieve optimum common mode rejection and may possibly correct the problem.

7.4.1.2. Interference Only When ASU is Activated

1. Check all connections to the ASU, and active accessory to look for possible metal-to-metal sparking.
2. If interference continues when the ASU is activated and while the electrode is not in contact with the patient, the monitor is responding to radio frequencies. Some manufacturers offer RF choke filters for use in the monitor leads. These filters reduce interference while a generator is activated. RF filters minimize the potential for an electrosurgical burn at the site of the monitor electrode.
3. Check that the ground wires in the operating room are electrically consistent. All ground wires should go to the same grounded metal with wires that are as short as possible.
4. If the above steps do not remedy the situation, contact AtriCure Technical Support to arrange evaluation of the ASU.

7.4.2. Neuromuscular Stimulation

1. Stop the surgery.
2. Check all connections to the ASU and active electrodes to look for a possible metal-to-metal spark.
3. If no problems are found, contact AtriCure Technical Support to arrange evaluation of the ASU for abnormal 50/60 Hz AC leakage current.

7.4.3. Pacemaker Interference

1. Check all connections.
2. Always monitor pacemaker patients during surgery.
3. Always keep a defibrillator available during electrosurgery on patients with pacemakers.
4. Consult the pacemaker manufacturer for specific recommendations.

8. Replacing Fuses

If the ASU does not Power ON and you have gone through the Troubleshooting **Section 7.0** of this manual, replace the fuses. There are no other user replaceable parts.

8.1. Tools Needed

Tools needed to complete Replacement of the Fuses:

- Small flat headed screwdriver.
- Two (2) fuses. Available through AtriCure. Part Number C000322 or as described under **Section 3.5**.

8.2. Procedure

The ASU unit has been pre-set at the factory to either 110V – 120V or 220V – 240V. The Input Voltage Selector Switch on the back panel of the ASU indicates the selected Input Voltage for this unit. The operator should not adjust The Input Voltage Selector Switch. This setting should only be adjusted by the manufacturer or by an authorized AtriCure technical service representative.

NOTE: ASU should be powered off and unplugged before continuing with the fuse replacement procedure.

1. Determine the voltage selected for this unit by looking at the Input Voltage Selector Switch. The voltage that has been selected will be indicated by a dot above the voltage.
2. Note the orientation of the two voltages written on the back of the fuse box before removing it. The one that is on the lower right, indicated with an arrow, should correspond with the voltage indicated by the Input Voltage Selector Switch.
3. Insert the Screw Driver into the access strip along the top seam of the fuse box. Use this to pry the fuse box from the power entry module on the back panel of the ASU.
4. Replace the (2) two fuses located in the fuse box. Make sure the fuses are lined up straight.
5. Line up the fuse cartridge so the voltage on the fuse box that is pointing down at the indication arrow in the lower right corresponds with the Input Voltage for this unit.
6. Put fuse box back into power entry module.
7. Confirm operational status by plugging in the ASU and powering it up. Check to see that the self-test is completed without errors.

9. Cleaning and Disinfecting

9.1. ASU Cleaning and Disinfection Instructions

Use a mild detergent and damp cloth to clean the ASU cover, front panel, and power cable. The ASU cannot be sterilized. Do not allow fluids to enter the chassis. The ASU may be disinfected using a standard hospital alcohol solution applied with a cloth.

NOTE: Do not spray or pour liquids directly on the unit.



WARNING: To avoid igniting flammable vapors, use only non-flammable agents to clean and disinfect the ASU. If flammable agents are inadvertently used on the ASU, allow these substances to evaporate completely before operating.

9.2. Footswitch Cleaning and Disinfection Instructions

Use a mild detergent (prepared to the manufacturer's specifications) and a damp cloth to clean the exterior of the Footswitch and cord. Do not allow fluids to enter the chassis. Take care not to wet the electrical connector on the cable. Do not use caustic, corrosive, or abrasive cleaning materials. The Footswitch cannot be sterilized. The Footswitch may be disinfected using a standard hospital alcohol solution applied with a cloth.

10. AtriCure Contact Information

If further assistance is needed, please contact AtriCure Technical Support.